Congressional Notification Profile
DE-PS26-02NT41369

UNIVERSITY COAL RESEARCH PROGRAM, INNOVATIVE CONCEPTS PROGRAM
The Pennsylvania State University

Background and Technical Information:
Project Title: "Reaction Mechanism of Magnesium Silicates with Carbon Dioxide in Microwave Fields."

This project proposes to use the science behind microwave ovens to speed the rate at which magnesium silicates absorb carbon dioxide in flue gas streams. Two sets of experiments are outlined. The first involves directly exposing a CO_2 gas stream containing water vapor to magnesium silicates in modest temperatures in a microwave cavity. Reaction times as a matter of temperature, water vapor, partial pressure and particle size would be recorded. The second series of tests would expose aqueous solutions to CO_2 in high pressures and temperatures in a Teflon reactor in a microwave field. Microwave processing would be compared with non-microwave techniques that use similar compositions, temperatures and pressures.

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Congressional District: 05 District County: Centre

Financial Information:

Length of Contract (months): 12
Government Share: $50,000
Total value of contract: $50,000

DOE Funding Breakdown:
Funds: FY 2002 $50,000

Reaction Mechanism of Magnesium Silicates with Carbon Dioxide in Microwave Fields

UCR Innovative Concepts, Phase I Program

Public Abstract

The proposed research concerns the sequestration of CO_2 by reactions with the magnesium silicates to produce environmentally benign $MgCO_3$.

$$Mg_2SiO_4 + 2\ CO_2 \rightarrow 2\ MgCO_3 + SiO_2$$

$$Mg_3Si_2O_5(OH)_4 + 3\ CO_2 \rightarrow 3\ MgCO_3 + 2\ SiO_2 + 2\ H_2O$$

These reactions are thermodynamically favorable but suffer from exceedingly slow reaction rates. Research by others has shown that reaction rates can be accelerated by use of aqueous carbonate solutions and high CO_2 pressures. The proposed research offers an alternative rate enhancement mechanism through the use of microwave fields.

Two series of experiments are proposed. In series (1) a gas stream of CO_2 containing variable amounts of water vapor would be reacted directly with the magnesium silicates at modest temperatures in a microwave cavity. The objective would be to determine the rate of reaction as a function of temperature, water vapor partial pressure, magnesium silicate particle size, and microwave power. In Series (2) experiments, aqueous solutions would be reacted with CO_2 under pressures up to 80 bars and temperatures up to 200 C in a Teflon high-pressure reactor in a microwave field. On objective of this portion of the research would be to compare the efficacy of microwave processing with similar compositions, temperatures, and pressures without microwaves.

The research project will be under the joint supervision of professors William B. White and Michael R. Silsbee, both of whom have extensive experience with chemical reactions at modest temperatures in ceramic and mineralogic systems. The project will take advantage of Penn State's Center for Microwave Processing, which is housed in the Materials Research Institute.

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